

Furnace for heating a preform, provided with two cooling fans

The invention relates to a furnace for heating a preform, especially a plastic container preform.

The invention relates more particularly to a furnace for
5 heating a preform, especially a plastic container preform, which
comprises a longitudinal heating tunnel bounded transversely by
the mutually parallel longitudinal vertical internal faces of two
walls, one a heating wall, being equipped with a heating system,
and the other an aerated wall, having aeration orifices that are
10 intended to let the air blown by a blower pass through them
transversely from the upstream, outside the heating tunnel, to the
downstream, inside the latter, and in which furnace a first portion
of the preform is heated in the heating tunnel, while the second
portion of the preform is held outside the heating tunnel through a
15 longitudinal opening made between the longitudinal edges of the
walls of the heating tunnel, the blower blowing air transversely to
the second portion of the preform so as to keep the constituent
material of this second portion of the preform at a temperature
below its softening point.

20 Plastic containers, and especially bottles, for example
made of polyethylene terephthalate (PET), are generally produced
from preforms that are shaped into bottles by an operation of blow
or stretch-blow moulding of their body and their end wall. The
preforms generally have the form of a test tube, the neck of which
25 already has the final shape of the throat of the container to be
produced. The neck has for example a thread intended to receive
a screw stopper.

Before carrying out the blow moulding operation, it is
necessary to heat the preforms in a heating furnace so as to
30 soften the plastic. For this purpose, the constituent plastic of the
preforms is heated to a temperature above its glass transition
temperature.

Preform heating furnaces of the type having a longitudinal
heating tunnel are already known. The cold preform is transported

by a transport device from a first end of the tunnel and then travels along the tunnel, in which it is heated, before emerging via the second end of the tunnel. The preform thus heated is ready for the blow moulding operation.

5 To ensure depthwise heating of the end wall and the cylindrical wall of the body of the preform over its entire periphery, the preforms are generally rotated about themselves as they travel through the furnace. Moreover, one wall of the tunnel is equipped with radiation heating means, while the other wall is
10 provided with aeration orifices for blown air to flow through so as to promote uniform heating throughout the thickness of the cylindrical wall of the body of the preform without overheating the layer of surface material forming the external face of the cylindrical wall of the preform.

15 In fact, the blown air removes the convective heat caused by the heating means, in order to promote penetration of the radiation that it produces in the thickness of the constituent material of the body.

 However, the neck of the preform, which has its final shape
20 and its final dimensions, must not be deformed during the heating and/or blow moulding operations. It is therefore essential to keep the neck at a temperature below the glass transition temperature. For this purpose, the neck of the preform is held outside the tunnel through an opening in the tunnel that forms a longitudinal
25 slot.

 To prevent the heat from the heating tunnel from being communicated to the neck of the preform, said neck is cooled by air blown by a blower.

 It is known to equip furnaces with a single blower, which
30 makes it possible, on the one hand, to distribute the heat uniformly in the heating tunnel and, on the other hand, to cool the neck of the preform. The blower is then equipped with a deflector, which is located upstream of the tunnel and of the preform

relative to the flow direction of the air. The deflector thus deflects a portion of the stream of blown air on to the neck of the preform.

The aim of the present invention is to improve the effectiveness with which the neck of the preform is cooled during the heating operation, while optimally keeping the surface layer of the body of the preform at a temperature close to the glass transition temperature of the plastic. For this purpose, the invention proposes a furnace of the type described above, characterized in that the blower comprises two independent fans that deliver air to the aerated wall and to the second portion of the preform held outside the heating tunnel, respectively.

According to other features of the invention:

- the delivery ducts are formed by the upper and lower compartments of a common box having a dividing partition;
- 15 - the blower includes two separate air inlet ducts that are each associated with a fan;
- the blower includes two coaxial vertical shafts, each driving an associated fan;
- the speed of the air stream expelled by the fan associated with the aerated wall is controlled by a control device;
- 20 and
- the fans are controlled by two separate control units.

Other features and advantages of the invention will become apparent on reading the following detailed description, for the understanding of which the reader should refer to the appended drawings, in which:

- Figure 1 is a side view showing a preform intended to be heated in a furnace before being converted into a container after a blow moulding operation;
- 30 - Figure 2 is a side view showing an furnace for heating the preform of Figure 1 and produced according to the teachings of the invention; and

- Figure 3 is a cross-sectional view in the plane 3-3 of Figure 2, showing the furnace equipped with a blower comprising two fans.

5 In the rest of the description, a longitudinal, vertical and transverse orientation, indicated by the (L,V,T) coordinate system shown in Figure 2, will be adopted, but without being limited thereby.

In the rest of the description, an upstream-to-downstream orientation will be used to describe the flow of air.

10 The same references will also be used to denote identical, similar or analogous elements.

Figure 1 shows a preform 10 made of a plastic, such as polyethylene terephthalate (PET), which is intended to be converted into a plastic container after a first operation, in which
15 it is heated to soften the plastic, and then a second operation, in which it is blow moulded in order to shape the preform 10 into a container.

The preform 10 has a test tube shape of vertical axis A. The tubular body 12 of the preform 10 is closed at its upper end
20 by a hemispherical end wall 14, while its lower end includes a neck 16 that forms a throat.

The neck 16 already has the final shape of the throat of the finished container. Thus, to obtain a finished container, only the tubular body 12 and its end wall 14 have to be deformed by blow
25 moulding. During the blow moulding operation, it is therefore important to heat only a first portion of the preform 10, comprising the tubular body 12 and the end wall 14, above the glass transition temperature of the plastic, while keeping the temperature of the neck 16, forming a second portion of the
30 preform 10, below the glass transition temperature.

The neck 16 is bounded at the top by a flange 18. The external cylindrical face 20 of the neck here has a thread that is intended to receive a threaded stopper (not shown) so as to seal the container.

Figure 2 shows an furnace 22 for heating the preform 10 during the heating operation. The furnace 22 comprises here a longitudinal heating tunnel 24 through which the preform 10 is intended to move along the direction indicated by the arrow F. The tunnel 24 has a first end 26 where the preform 10 enters, on the right in Figure 2, and a second end 28 where the preform 10 leaves, on the left in Figure 2.

As illustrated in Figure 2, the furnace 22 includes a device 30 for transporting the preform 10 from the inlet 26 to the outlet 28 of the furnace 24. The transport device 30 comprises a train of mandrels 32 for gripping the preforms 10, these mandrels extending vertically upwards from a lower rail 34 which runs beneath the tunnel 24 so as to be parallel therewith. The mandrels 32 are intended to keep the preforms 10 vertical during their travel along the tunnel 24.

The rectilinear longitudinal shape of the tunnel 24 as shown in Figure 2 is given by way of non-limiting example.

Figure 3 shows a section of the tunnel 24. It is bounded transversely by two mutually parallel vertical longitudinal internal faces 36 and 38 belonging to a first wall 40, located on the right in Figure 3, and to a second wall 42, located on the left, respectively.

The tunnel 24 here is closed neither at the top nor at the bottom. Thus, the lower longitudinal edges of the internal faces 36 and 38 define a lower opening 41 in the form of a longitudinal slot.

The first wall 40 is equipped with a heater 46 for heating the tunnel 24. In the example shown in Figure 3, the heater 46 comprises eight infrared lamps, which here are referenced IR1 to IR8 and have the form of longitudinal tubes. The tubes IR1 to IR8 are held by each of their ends close to the internal face 36 of the first wall 40 using means, here vertically distributed longitudinal channels 48, each intended to house one end of the lamps IR1 to IR8.

The second wall 42 here includes orifices 50 that pass transversely through its thickness so as to allow a stream of air produced by a blower 52 to penetrate into the tunnel 24. As explained in the preamble, the stream of air thus cools the surface layer of material forming the external face of the cylindrical wall of the preform 10.

As shown in Figure 3, the tubular body 12 and the end wall 14 of the preform 10 are held inside the heating tunnel 24, while the neck 16 and the flange 18 are held outside the tunnel 24, passing through the lower opening 41.

To keep the neck 16 at a temperature below its glass transition temperature, a stream of fresh air is blown transversely towards the neck 16 by the blower 52.

The blower 52 is located transversely to the left of the second wall 42 in Figure 3.

According to the teachings of the invention, the blower comprises two separate blowers, namely an upper blower 54a and a lower blower 54b. In the rest of the description, the references for the components of the upper fan 54a will be followed by the letter «a», while the references for the components of the lower fan 54b will be followed by the letter «b».

Each fan 54a and 54b mainly comprises a motor-driven bladed wheel 56a and 56b, also called a turbine, which is mounted so as to rotate about a vertical axis B, a vertical axial air inlet duct 58a, 58b and a transverse tangential air outlet or delivery duct 60a, 60b. The fans 54a and 54b are overall symmetrical with respect to a horizontal mid-plane, that is to say the bladed wheels 56a and 56b and the delivery ducts 60a and 60b are adjacent, while the inlet ducts 58a and 58b are oriented in the opposite direction.

The bladed wheels 56a and 56b are mounted so as to rotate about the same vertical axis B. They are each rotated by an associated motor 62a and 62b via a shaft 64a, 64b. The motors

62a and 62b here are placed vertically between the two bladed wheels 56a and 56b.

In an alternative embodiment (not shown) of the invention, the motors 62a and 62b are located some distance from the fans 54a and 54b and they drive the shafts 64a and 64b via movement
5 transmission mechanisms, such as belts. The two bladed wheels 56a and 56b may thus be brought close to each other vertically so that the blower 52 is more compact heightwise.

The air inlet ducts 58a and 58b are placed vertically along
10 the axis B of the bladed wheels 56a and 56b, one opposite the other.

Thus, the air inlet duct 58a of the upper fan 54a extends vertically above the bladed wheel 56a so as to take in air from above the blower 52 downwards into the bladed wheel 56a.

15 The air inlet duct 58b of the fan 54b extends vertically below the bladed wheel 56b so as to take in air from below the blower 52 upwards into the bladed wheel 56b.

The delivery ducts 60a and 60b are oriented transversely to the tunnel 24 and are adjacent to each other.

20 In the example shown in Figure 3, they are formed in a common output box 66, which is divided into two compartments, an upper compartment 60a and a lower compartment 60b, by a horizontal partition 68 being substantially in the plane of symmetry of the two fans 54a and 54b. The first, upstream
25 transverse end 70 of the box 66, located on the left and at the outlet of the bladed wheels 56a and 56b with regard to Figure 3, and the second, downstream transverse end 72 include openings so as to let a stream of air flow transversely from the bladed wheels 56a and 56b into the tunnel 24 and the neck 16
30 respectively.

The upper compartment 60a thus forms a delivery duct that extends transversely from the bladed wheel 56a to the second wall 42 of the heating tunnel 24.

The lower compartment 60b thus forms a delivery duct that extends transversely from the lower bladed wheel 56b into the region of the neck 16 of the preform 10.

Advantageously, the motors 62a and 62b are controlled by
5 two separate control units. It is thus possible to regulate the stream of air passing through the second wall 42 by acting on the upper fan 54a, without modifying the stream of air needed to cool the neck 16.

During operation of the blower 62, the motors 62a and 62b
10 rotate the bladed wheels 56a and 56b which induct air via the axial inlet ducts 58a and 58b as shown by the arrows in Figure 3.

The upper bladed wheel 56a blows the air, thus inducted,
into the upper delivery duct 60a. The delivered air passes through the orifices 50 of the second wall 42 so as to penetrate into the
15 tunnel 24.

The lower bladed wheel 56b blows the air, thus inducted,
into the lower delivery duct 60b. The delivered air is directed directly on to the neck 16 so as to cool the latter.

According to an alternative embodiment (not shown) of the
20 invention, the inlet duct 58b of the lower fan 54b is contained coaxially inside the inlet duct 58a of the upper fan 54a. The downstream end section of the inlet duct is extended downwards through a vertical recess reserved in the axis of the hub of the upper bladed wheel 56a, and then the air thus flowing through the
25 hub is inducted by the lower bladed wheel 56b before being delivered into the lower delivery duct 60b. Advantageously, this configuration prevents the lower fan 54b from sucking up elements likely to be beneath the furnace 22, for example dust on the floor beneath the furnace 22.